

## SECTION 2: TREATMENT OF THE VALUES OF LIFE AND INJURY IN ECONOMIC ANALYSES

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### 2.1 APPROACH

This section addresses the treatment of the values of life and injury in economic analyses that support rulemakings or investment decisions in the FAA. It is based on guidance furnished by Office of the Secretary of Transportation (OST) via memorandum January 8, 1993. This guidance provides recommendations to all modal administrators on the treatment of the values of life and injury in economic analyses. It specifies that values of life and injury be based on the "willingness to pay" (WTP) by society for reduced risks of fatalities and injuries.<sup>1</sup>

WTP is the theoretically correct approach to valuing all benefits arising from public investments or regulatory actions including fatalities and injuries avoided as a result of aviation accident risk reduction. This is because it represents the maximum amount of value yielded by other goods and services individuals would be willing to forgo and still be as well off after the introduction of an accident risk reduction as they were before it.

The basic approach taken to value an avoided fatality is to determine how much an individual or group of individuals is willing to pay for a small reduction in risk. Once this amount is known, it is necessary to determine how much risk reduction is required to avoid one fatality. The total willingness to pay for the amount of risk reduction required to avoid one fatality is termed the value of life or sometimes the value of a statistical life.<sup>2</sup> For example, if people are willing to pay \$2.70 to reduce the risk of a fatality by one chance in one million, this implies they will be willing to pay \$2.7 million to prevent one fatality. From another perspective, \$2.7 million represents the amount a group as a whole would be willing to pay to purchase the risk reduction necessary to avoid one expected fatality among its members.

In theory, the same approach could be used to value injuries. However, in practice it cannot currently be done because of data limitations. As will be indicated below, an alternative approach is used which values avoided injuries as a fraction of an avoided fatality.

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<sup>1</sup> "Treatment of Value of Life and Injuries in Preparing Economic Evaluations," Office of the Secretary of Transportation Memorandum, January 8, 1993.

<sup>2</sup> The terms value of life and value of statistical life are misleading at best in that they refer to the sum of payments associated with many small fatality risk reductions undertaken prior to the occurrence of a fatality. They have no application to the actual death of any identifiable individual.

## 2.2 VALUE OF LIFE

For analyses conducted in 1993, OST guidance suggested that \$2.5 million be used as the minimum value of a statistical fatality avoided. This value was based upon a survey of studies performed by Ted Miller and others at the Urban Institute, adjusted to 1993 dollars.<sup>3</sup> The OST guidance also provided that OST would update this value early each year using the Gross Domestic Product implicit price deflator. Subsequently, OST updated the value of life for analyses to be conducted in 1994 to \$2.6 million per fatality averted.<sup>4</sup> The latest OST guidance establishes a minimum value of \$2.7 million per fatality averted.<sup>5</sup> This \$2.7 million value and the injury values based on it (presented below) should be used in all FAA analyses until revised by OST.

## 2.3 VALUE OF INJURIES

The January 8, 1993, OST guidance also establishes a procedure for valuing averted injuries based on the current value of life and the Abbreviated Injury Scale (AIS). AIS is a comprehensive system for rating the severity of accident-related injuries which recognizes six levels of injury severity. It classifies nonfatal injuries into five categories depending on the short-term severity of the injury. A sixth category corresponds to injuries that result in death after 30 days of the accident. The five nonfatal AIS categories are based primarily upon the threat to life posed by an injury. Table 2-1 gives an overview of the classification of different injuries by AIS level and their threat to life.

To establish valuation for each AIS severity level injury, the level is related to the loss of quality and quantity of life resulting from an injury typical of that level. This loss is expressed as a fraction of a fatality. WTP to avoid an injury of a particular AIS level is estimated by multiplying the fractional fatality value associated with the AIS level by the value of life. AIS levels, their associated fractional fatality values,<sup>6</sup> and the corresponding WTP value of each injury level (based on a \$2.7 million value of life) are provided in Table 2-2.

Where specific information is available on separate injuries by AIS level, the Office of Aviation Policy and Plans (APO) recommends that the WTP to avoid each specific injury be separately valued according to Table 2-2. Often, more than one injury will be associated with a person injured in an aviation accident. If valuation is to be presented on a per victim basis, WTP values for each injury suffered by the same person should be aggregated.

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<sup>3</sup> The Urban Institute, *The Cost of Highway Crashes*, Final Report, June 1991.

<sup>4</sup> "Update of Value of Life and Injuries for Use in Preparing Economic Evaluations," Office of the Secretary of Transportation Memorandum, March 15, 1994.

<sup>5</sup> "Update of Value of Life and Injuries for Use in Preparing Economic Evaluation," Office of the Secretary of Transportation Memorandum, March 14, 1995.

<sup>6</sup> These values were derived from Ted R. Miller, C. Philip Brinkman, and Stephen Luchter, "Crash Costs and Safety Investments," *Proceedings of the 32nd Annual Conference*, Association for the Advancement of Automotive Medicine, Des Plaines, Illinois, 1988.

**Table 2-1****Selected Sample of Injuries by the  
Abbreviated Injury Scale (AIS)**

AIS Code	Injury Severity Level	Selected Injuries
1	Minor	Superficial abrasion or laceration of skin; digit sprain; first-degree burn; head trauma with headache or dizziness (no other neurological signs).
2	Moderate	Major abrasion or laceration of skin; cerebral concussion (unconscious less than 15 minutes); finger or toe crush/amputation; closed pelvic fracture with or without dislocation.
3	Serious	Major nerve laceration; multiple rib fracture (but without flail chest); abdominal organ contusion; hand, foot, or arm crush/amputation.
4	Severe	Spleen rupture; leg crush; chest-wall perforation; cerebral concussion with other neurological signs (unconscious less than 24 hours).
5	Critical	Spinal cord injury (with cord transection); extensive second- or third-degree burns; cerebral concussion with severe neurological signs (unconscious more than 24 hours).
6	Fatal	Injuries which although not fatal within the first 30 days after an accident, ultimately result in death .

**Table 2-2****WTP Values Per AIS Injury Level**

AIS Code	Description of Injury	Fraction of WTP Value of Life	WTP Value
AIS 1	Minor	0.20 Percent	\$5,400
AIS 2	Moderate	1.55 Percent	\$41,900
AIS 3	Serious	5.75 Percent	\$155,300
AIS 4	Severe	18.75 Percent	\$506,300
AIS 5	Critical	76.25 Percent	\$2,058,800
AIS 6	Fatal	100.00 Percent	\$2,700,000

## 2.4 OTHER COSTS

Costs other than WTP values are generally associated with transportation fatalities and injuries. These include the costs of emergency services, medical care, and legal and court services (the cost of carrying out court proceedings--not the cost of settlements). These other avoided costs should be considered as separate benefits, additional to the WTP value.

Because medical and legal costs of separate injuries to the same victim are not necessarily additive, APO advises that medical and legal costs be valued on a per victim basis. Table 2-3 provides direct per victim medical and legal costs classified according to the worst AIS injury sustained by each aviation accident victim. Thus, the values in Table 2-3 should be added only once to the aggregated sum of the WTP values for injuries suffered by any particular individual.<sup>7</sup>

**Table 2-3**

**Per Victim Medical and Legal Costs Associated with Injuries  
(1998 dollars)**

AIS Code	Description of Maximum Injury	Emergency/ Medical	Legal/Court	Total Direct Costs
AIS 1	Minor	\$600	\$1,700	\$2,300
AIS 2	Moderate	\$3,500	\$2,800	\$6,300
AIS 3	Serious	\$14,500	\$4,300	\$18,800
AIS 4	Severe	\$63,700	\$35,500	\$99,200
AIS 5	Critical	\$193,500	\$72,700	\$266,200
AIS 6	Fatal	\$46,300	\$72,700	\$119,000

Source: *Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs*, FAA-APO-89-10, October 1989, Section 3 , as adjusted for price level changes.

## 2.5 ICAO INJURY CLASSIFICATIONS

Although the methodology specified above should be used when possible, aviation injury data are often incomplete and/or unavailable at the AIS level. Most frequently, aviation injuries

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<sup>7</sup> Similar direct costs apply in the case of fatalities. However, APO estimates that these direct costs are less than \$50,000 per fatality--not enough to shift the \$2.7 million WTP value after allowances for the rounding convention--to the nearest \$100,000--used by OST.

are reported by the number of victims suffering "serious" and "minor" injuries as defined by the International Civil Aviation Organization (ICAO). Under this classification, serious injury victims are typically (but not always) those with at least one injury at AIS 2 or higher, whereas minor injury victims typically (but not always) have injuries at the AIS 1 level only.

To calculate economic values for the ICAO serious and minor injury categories, APO analyzed aviation injury data maintained by the National Transportation Safety Board (NTSB) that contain both ICAO and complete AIS injury codes. AIS values for all injuries sustained by accident victims in each ICAO category were summed and then divided by the number of victims in each category to determine per victim WTP values.<sup>8</sup> These WTP values are reported in Table 2-4. Medical and legal direct costs reported in Table 2-4 reflect weighted averages of the values listed in Table 2-3.

**Table 2-4**

**Average Per Victim Injury Values for Serious and Minor Injuries**

ICAO Code	Description of Maximum AIS Injury	WTP Values	Emergency/ Medical	Legal/ Court	Total Value
MINOR (ICAO 2)	AIS 1	\$34,000	\$2,000	\$2,500	\$38,500
SERIOUS (ICAO 3)	AIS 2 to 6	\$482,000	\$27,600	\$12,200	\$521,800

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<sup>8</sup> Eric Gabler, "Update of FAA Values of Avoided Injury," Draft Working Paper, Office of Aviation Policy and Plans, February 1994.